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(54) **Forming a waterproofing layer on a surface using preformed flexible laminates**

(57) Pre-formed waterproofing laminates are applied side-by-side on the surface 6. Each laminate has a flexible sheet-like support 2 non-removably attached to one face of a layer of a waterproofing, bituminous adhesive composition 1. The other face of support 2 is non-adherent. A removable protective sheet 3 covers the other face of adhesive layer 1. The laminates are applied with the non-adherent surfaces of supports 2 adjacent to surface 6. Protective sheets 3 are then removed from said laminates to expose adhesive layers 1 which are then covered with granular weathering material which adheres to the laminates. The arrangment allows vapour beneath the waterproofing layer to move between it and the substrate. Adjacent laminates may overlap.

Protective sheet 3 may have perforations 5 allowing portions of the sheet to be selectively removed.

FIG. 1

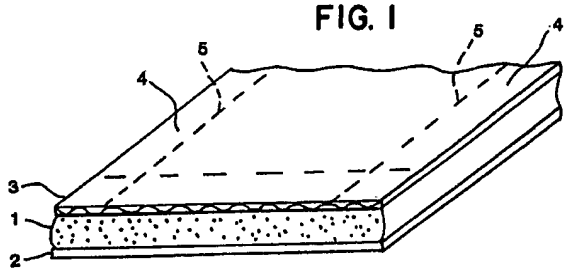

FIG. 2

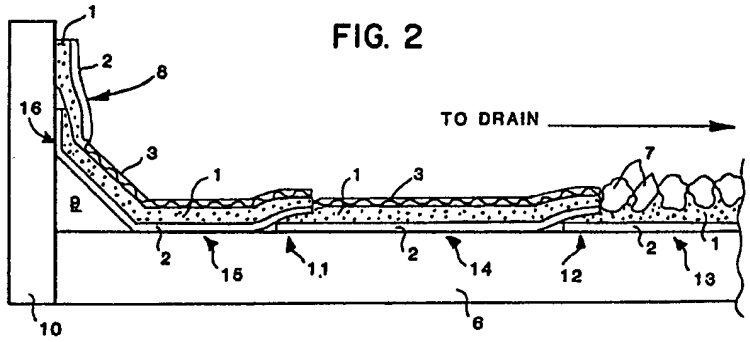

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FIG. 1

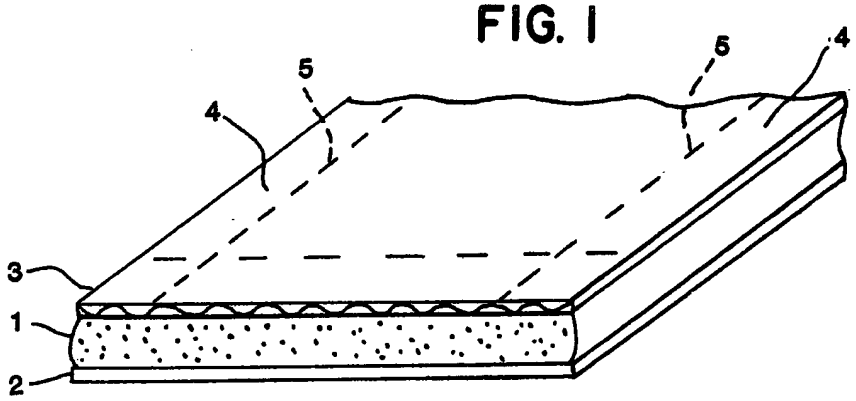
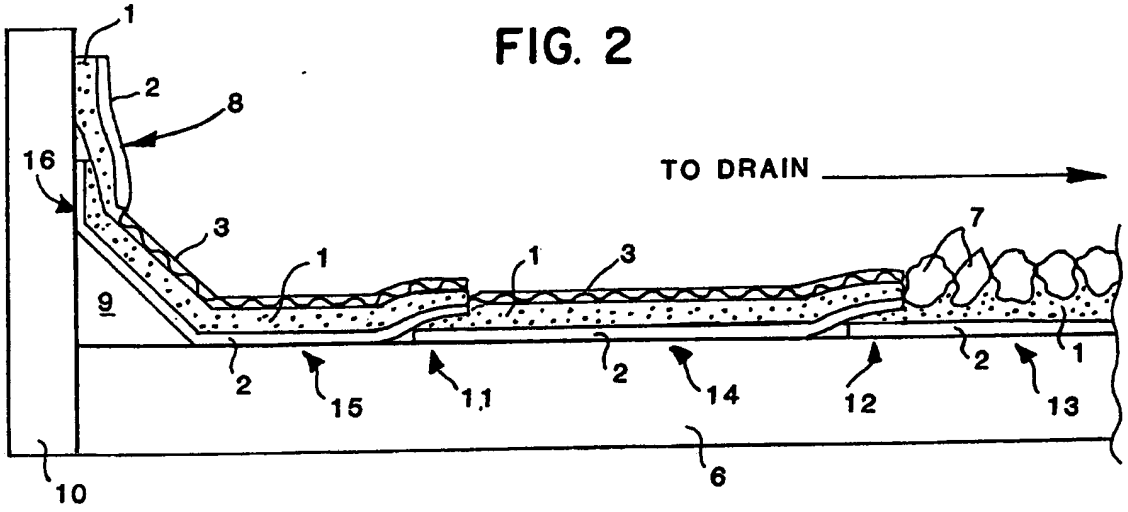


FIG. 2



SPECIFICATION

Method of forming a waterproofing layer

This invention relates to a method of forming a waterproofing layer, for instance on a roof. In particular, the invention concerns a method wherein a continuous impervious membrane is formed upon a surface such as a roof but the membrane is attached to the roof in a way which permits movement of moisture in and from the roof, rather than being adhered throughout its area to the roof.

Roofs exposed to the weather must be provided with a continuous layer impermeable to water, that is to say a waterproofing membrane. The traditional way involves providing a membrane which comprises several plies of asphalt-impregnated felt bonded together with hot or cold-applied asphalt, tar or other adhesive. The bonding of the several plies together is usually accomplished in situ upon the roof; hence the terminology "built-up waterproofing membrane"

Flexible sheet-like laminates including a support film and self-adhesive bituminous waterproofing layer, and which are pre-formed in the factory, have, however, been successfully employed in roofing and other waterproofing applications as substitutes for the aforedescribed "built-up" waterproofing membranes. The pre-formed, self-adhesive laminate-membranes offer many advantages including factory controlled preparation, avoidance of heating equipment and handling of hot materials at the job site, as well as many performance advantages.

flexible pre-formed laminates of the aforementioned type and their use to form waterproofing layers in various kinds of building structures are described for example in British Patents Nos. 1,230,753 to 1,230,756, 1,265,952, 1,341,413 and 1,400,385. Such Patents describe in particular laminates containing a support material, for example a layer of a polymeric or metallic film, which is non-removably joined to a layer of a self-adhesive waterproofing composition which is generally a bitumen-elastomer mixture. Such laminates can be provided with a siliconized paper release sheet applied against the side of the self-adhesive bituminous waterproofing layer remote from the support material. For use, the release sheet is removed and the laminates placed adhesive side down on the surface.

However, in certain roofing applications, it is necessary or desirable for the waterproofing membrane layer not to be adhered over its entire lower surface to the roof substrate or deck. For example, many roofing systems incorporate as the, or as part of the, thermoinsulation in the roof, one or more layers of lightweight cementitious thermoinsulating concretes. Such concretes typically comprise mixtures of a hydratable cementitious binder such as Portland cement or gypsum, and a lightweight low-density aggregate. Chemical additives such as surfactants may further be present to entrain air. The concretes are usually prepared at the job-site by mixing water with the dry ingredients, pumping the wet mix to the rooftop, casting the wet concretes upon the roof and thereafter allowing the concrete to hydrate or dry. Moisture remaining in such concrete layers after installation of the waterproofing membrane thereover can become a problem on hot days in that the vapour can cause blistering of the membrane. To avoid this, the waterproofing membranes used on such surfaces are not adhered all over, but have areas of non-adherence so that they can be spaced from the roofdeck and allow room for movement of moisture beneath the membrane. To provide bonding of the membrane to the roof and to increase its resistance to wind effects, the membrane is for instance "spot-bonded", e.g., adhered to the deck by spaced-apart roofing nails which leave sufficient space beneath the membrane for moisture movement.

If self-adhesive waterproofing membrane laminates of the type shown in the aforementioned patents were applied to roofing systems requiring spacing between the membrane and the roofdeck, a separator sheet would be necessary to negate the adhesion between the self-adhesive bituminous layer and the roofdeck. Also, to hold a weathering layer of gravel or mineral chips to the surface of the membranes, a coating of gravel adhesive must first be applied. The gravel, *inter alia*, protects the upper plastic film support from ultraviolet radiation. The use of such separator sheets and application of such gravel adhesive after installation of the membrane laminates however leads to increased costs of labour and material and also slows the installation rate of the waterproofing membrane system.

According to the present invention there is provided a method of forming a continuous waterproofing layer upon a surface, said method including the steps of applying in side-by-side arrangement on the surface a plurality of pre-formed waterproofing laminates, each such laminate having, at the time of application, a flexible sheet-like support non-removably attached to one face of a layer of a waterproofing, bituminous adhesive composition and having a non-adherent surface remote from the adhesive, and a removable protective sheet covering the face of said layer of adhesive composition remote from said sheet-like support, the laminates being applied with the non-adherent surfaces of the sheet-like supports adjacent said surface, removing said protective sheets from said laminates to expose said adhesive bituminous layers and covering said adhesive layers with granular weathering material so as to adhere said weathering material to the laminates.

It has been found that the self-adhesive waterproofing membrane laminates of the type described in the aforementioned patents are very useful for use over roofdecks wherein venting of moisture is desired or required, and that the appropriate way of employing them is, essentially, to invert them. The non-adhesive support layer

thus contacts the roofdeck or other surface, and the adhesive layer is thus uppermost and available to receive mineral chips when the release sheet is removed. The positioning of the laminate in this inverted manner avoids the necessity of using a separator sheet to negate the adhesion of the bituminous adhesive, and, after removal of the uppermost protective sheet from the adhesive, an adhesive layer is presented which can serve to adhere the customary weathering layer of mineral. An added advantage of the method of the invention is that the uppermost protective release sheet can be left on for a period of time to protect the applied laminate until the waterproofing job is completed and ready for the final application of gravel. Also, the arrangement causes the sheet-like support to be beneath the layer of bituminous adhesive where it is given added protection against exposure to ultraviolet.

The invention will be more clearly understood from the following description which is given by way of example only with reference to the accompanying drawings in which:—

Figure 1 is a perspective view of a preferred waterproofing laminate construction for use in the method of the invention; and

Figure 2 is a side view illustrating the waterproofing of a section of a roof according to the method of the invention.

Figure 1 shows a flexible laminate strip having a comparatively thick layer of self-adhesive bituminous water-proofing composition 1, contiguous to a thinner support layer 2, for example, a sheet of polymeric film. The layers 1 and 2 are well-bonded to one another, that is, they are not normally separable without some physical damage resulting. The self-adhesive bituminous waterproofing layer 1 will normally have sufficient adhesive properties that additional adhesive to bond it thoroughly to the support layer 2 will not be necessary. To protect the surface of the bituminous adhesive layer remote from layer 2, a removable protective sheet 3, for example a sheet of siliconized paper, is applied thereto. The sheet 3 adheres sufficiently to the bituminous adhesive to keep it in place during rolling up and handling of the laminate, but is easily removable therefrom without physical damage to the layer 1. To render the laminate strip easier to use, the protective sheet 3 has a series of perforations 5 adjacent one or more of its lateral edges. The perforations allow edge portions 4 of the sheet to be selectively removed during installation of the laminate without removal of the entire protective sheet 3. The flexible laminate strip shown in Figure 1 preferably has a width of 1 metre and a length of perhaps 20 metres and is conveniently produced in the form of a roll for delivery to the job-site.

The self-adhesive or pressure-sensitive bituminous waterproofing layer 1 may be of the type described in the abovementioned British Patents, that is, the adhesive composition can include a mixture of a bituminous material and natural or synthetic polymer, preferably a rubber or other elastomer polymer. The amount of polymer employed in such compositions can be anything from about 1 to 100, but preferably about 20 to 50, percent by weight, of the bituminous material. The term "bituminous material" as used herein includes compositions containing asphalt, tar such as coal tar, pitch, other coal extracts or bitumens or other petroleum products. The bituminous adhesive may be reinforced with fibres and/or particulate fillers. The adhesive composition may also contain a conventional extender component such as a mineral oil. Suitable polymer components include thermoplastic polymers such as polyethylene. As mentioned, the preferred polymer component is rubber which may be virgin rubber or a synthetic rubber which is blended into the bitumen, preferably with an extender oil component suitably added at elevated temperature to form a smooth mix. Suitable adhesive compositions generally have softening points (measured by the Ring and Ball method) of 70° to 120°C., preferably 75° to 100°C., and penetration values of 50 to 400, preferably 50 to 100 dmm. at 25°C. (150 g/5-ASTM D217), and are thermoplastic in nature.

In order to give optimum sealing and waterproofing performance the adhesive layer should be at least 0.025 cms. thick and preferably in the range of about 0.06 to about 0.5 cm. thick. The adhesive layer can be made up of one or more layers of the same or different bituminous adhesives, and can have a reinforcement such as an open weave fabric, gauze or scrim located therein to strengthen it. The adhesive layer 1, at least at its surface remote from support sheet 3 is pressure-sensitive and tacky at normal ambient temperature in order that it be self-adhesive to the substrate. The bituminous adhesive layer serves to form a continuous waterproofing layer which is elastic and self-sealing against punctures at high and low temperature, and also as an adhesive for weathering material applied to the laminate at the job site.

The support layer 2 serves as a strength imparting and supporting member in the laminate and also as a barrier to prevent moisture vapour transmission through the laminate. Thus while of less thickness than the bituminous waterproofing layer 1, the support layer 2 should be of sufficient thickness to assist in giving tear and puncture resistance to the laminate. The support layer 2 suitably has a thickness in the range of from about 0.005 to about 0.06 cms., preferably from about 0.01 to about 0.025 cms.

Preferred sheet materials for use in the layer 2 are films of synthetic organic polymers such as polyethylene, polypropylene or other polyolefin; polyamide, polyester, e.g. polyethylene terephthalate, polyurethane, polyvinyl chloride, a copolymer of vinyl chloride and vinylidene chloride, synthetic rubber such as polychloroprene or butyl rubber, and metal films or foils such as of aluminium, copper and zinc.

The polymer films may be uniaxially oriented or cross-laminated polymer films or biaxially-oriented polymeric films. Any film-forming synthetic

polymer or copolymer which can be oriented (biaxially or cross-laminated) is useful. Biaxially oriented films of such polymers as polyolefins, e.g. high and low density polyethylene, vinylidene chloride, polystyrene, polyvinyl chloride, rubber hydrochloride, polyethylene terephthalate, etc., are commercially available. Especially useful films are biaxially oriented polyolefin and cross-laminated polyolefins. Preferred polymeric films for use as or in the support layer 2 are cross-laminated high density polyethylene films and biaxially oriented polyesters such as polyethylene terephthalate. The use of such cross-laminated films and biaxially-oriented films in waterproofing laminates is described for example in Canadian Patent No. 1,008,738 to Everett R. Davis.

In a particularly preferred embodiment, the adhesive in Figure 1 comprises a 0.08 cm. thick layer of a self-adhesive composition containing essentially asphalt, styrene-butadiene rubber and oil, and the layer 2 comprises a 0.02 cm. thick layer of a cross-laminated high density polyethylene film.

A sheet of paper, e.g. Kraft paper, having a coating thereon of silicone release composition as is well known in the art, may be used as the protective layer 3. Other sheet materials, for example clear plastic films, having the requisite release properties *per se* or release coatings thereon could be also be used.

In Figure 2, the laminate strip of Figure 1 is applied to a roofdeck 6 according to the method of the invention. In Figure 2, the thickness of the applied laminates is exaggerated for purposes of clarity.

Roofdeck 6 may be, for example, a layer of lightweight insulating concrete, optionally containing a layer of foamed insulation boards, such as insulated roofdeck shown and described in U.S. Patent No. 4,189,866. The lightweight insulating concretes described therein are prepared at the job site by mixing water, cement and lightweight aggregate such as expanded vermiculite or perlite, and thereafter casting the wet fluid mix upon a structural deck.

The laminate strips of Figure 1 are unrolled upon the deck 6 as shown, with the non-adhesive support layer 2 nearest the deck. The first laminate, 13 in Figure 2, is applied nearest the drain or down-side so that successively applied laminates 14 and 15 form overlaps in the manner shown in Figure 2 in order that water falling upon the finished roof does not flow directly into an overlapped joint.

As shown in Figure 2, the first applied laminate 13 is overlapped by the next applied laminate 14 at joint 12. Prior to overlapping by laminate 14, the marginal portion 4 of the protective sheet 3 of laminate 13 nearest joint 12 is removed, and roofing nails (not shown) are inserted through the exposed adhesive 1 and layer 2 into the deck 6. The lower face of support sheet 2 of laminate 14 is then placed over the exposed adhesive layer of laminate 13 and nailheads therein, forming overlap joint 12. An identical application procedure is followed for laminates 14 and 15 at overlap joint 11.

The margin of laminate 15 remote from laminate 14 extends over a cant strip 9 and up the inner face of parapet wall 10. The marginal portion 4 of the protective sheet 3 of laminate 15 is removed at joint 16 and laminate 15 nailed to the wall 10 at joint 16. Another strip 8 of waterproofing laminate is then applied adhesive side down in overlapping fashion upon the nailed exposed adhesive layer of laminate 15 forming a watertight joint at 16.

As shown in Figure 2, the exposed removable protective sheets 3 of laminates 14 and 15 are left in place serving as temporary protection until completion of the installation of the laminates upon the roof. Subsequently, each of the sheets 3 are removed and the final weathering layer of, for example, sand or gravel particles 7, is embedded in the exposed adhesive 1, as shown in Figure 2 in connection with laminate 13.

The result is a single-ply, integral, watertight waterproofing membrane which is anchored to the deck only at spaced intervals by the nails driven at the overlapped joints 11, 12 and 16. Since the laminates are otherwise non-adhered to the roofdeck, space is available between the deck and the membrane for movement or distribution of any moisture vapour building up beneath the membrane. If desired, vents (not shown) could be placed through the membrane to allow for passage of such moisture vapour to the atmosphere.

CLAIMS

1. A method of forming a continuous waterproofing layer upon a surface, said method including the steps of applying in side-by-side arrangement on the surface a plurality of pre-formed waterproofing laminates, each such laminate having, at the time of application, a flexible sheet-like support non-removably attached to one face of a layer of a waterproofing, bituminous adhesive composition and having a non-adherent surface remote from the adhesive, and a removable protective sheet covering the face of said layer of adhesive composition remote from said sheet-like support, the laminates being applied with the non-adherent surfaces of the sheet-like supports adjacent said surface, removing said protective sheets from said laminates to expose said adhesive bituminous layers and covering said adhesive layers with granular weathering material so as to adhere said weathering material to the laminates.

2. A method according to claim 1, wherein the laminates are successively overlapped along adjacent edges.

3. A method according to claim 2, wherein the protective sheets of the laminates are perforated adjacent at least one marginal edge thereof to provide a portion thereof separately-removable from said laminate, and said separately-removable portion is removed prior to overlapping of the laminate by a successively applied laminate.

4. A method according to claim 1, 2 or 3, wherein the surface is a roofdeck.

5. A method according to claim 4, wherein the roofdeck is of a layer of insulating concrete.

6. A method according to any preceding claim, wherein the laminates are mechanically attached, at intervals, to the surface.

7. A method according to any preceding claim, wherein said adhesive composition is a mixture of a polymer and a bituminous material.

8. A method according to claim 7, wherein said polymer is natural or synthetic rubber and said bituminous material is asphalt.

9. A method according to claim 8, wherein said adhesive composition additionally contains mineral oil.

10. A method according to any preceding claim, wherein said sheet support of the laminate has a thickness of from about 0.005 to about 0.06 cms., and said adhesive layer has a thickness of at least 0.025 cms.

11. A method according to any preceding claim, wherein said sheet support is a sheet of polymer film.

12. A method according to claim 11, wherein the polymer is one of polyolefin, polyester, polyurethane, polyvinyl chloride, a copolymer of vinyl chloride and vinylidene chloride, and synthetic rubber.

13. A method according to claim 11, wherein said polymer film is a cross-laminated polymeric film or a biaxially-oriented polymeric film.

14. A method according to claim 11 or 13, wherein said film is high density polyolefin.

15. A method according to any preceding claim, wherein said weathering material is sand or gravel.

16. A pre-forming flexible waterproofing laminate including a flexible sheet support non-removably adhered to one face of a normally tacky, self-adherent layer of a waterproofing bituminous adhesive composition, the surface of said sheet support remote from said bituminous adhesive being non-adherent, and a removable protective sheet covering the face of said adhesive layer remote from said support sheet, a portion of said removable protective sheet along at least one marginal edge thereof being adapted to be separately removable from said adhesive to expose the portion of said adhesive lying thereunder without at the same time exposing the remainder of said adhesive covered by said protective sheet.

17. A laminate according to claim 16, wherein said portion of said removable protective sheet is rendered separately removable by providing said sheet with a plurality of serrations therein.

18. A laminate according to claim 16 or 17, wherein said protective sheet is rendered separately removable from said adhesive along at least two marginal edges thereof.

19. A method of forming a continuous waterproofing layer on a surface substantially as hereinbefore described with reference to the accompanying drawings.

20. A pre-formed flexible waterproofing laminate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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